A brief assessment of SV candidates for IGRF-13

A. Fournier (fournier@ipgp.fr) & J. Aubert (aubert@ipgp.fr)

Université de Paris, Institut de physique du globe de Paris, CNRS, F-75005 Paris, France

November 22, 2019

1 Distance to the mean

We begin by computing the rms distance to the mean model (arithmetic mean) at Earth's surface, truncating the calculation at SH degree 8. We find the following values in nT/y

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        BGS   8.90
        NCEI 11.81
        DTU   3.89
        GFZ  10.68
        IPGP  7.66
     ISTerre  7.78
     IZMIRAN 12.39
       Japan 18.99
       Leeds  6.81
         MPS  6.01
        GSFC 26.67
 Potsdam-MPS  5.88
       Spain  6.23
  Strasbourg 20.96
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The spectrum of the distance of each model to the mean is shown for each spherical harmonic degree in Figure 1.

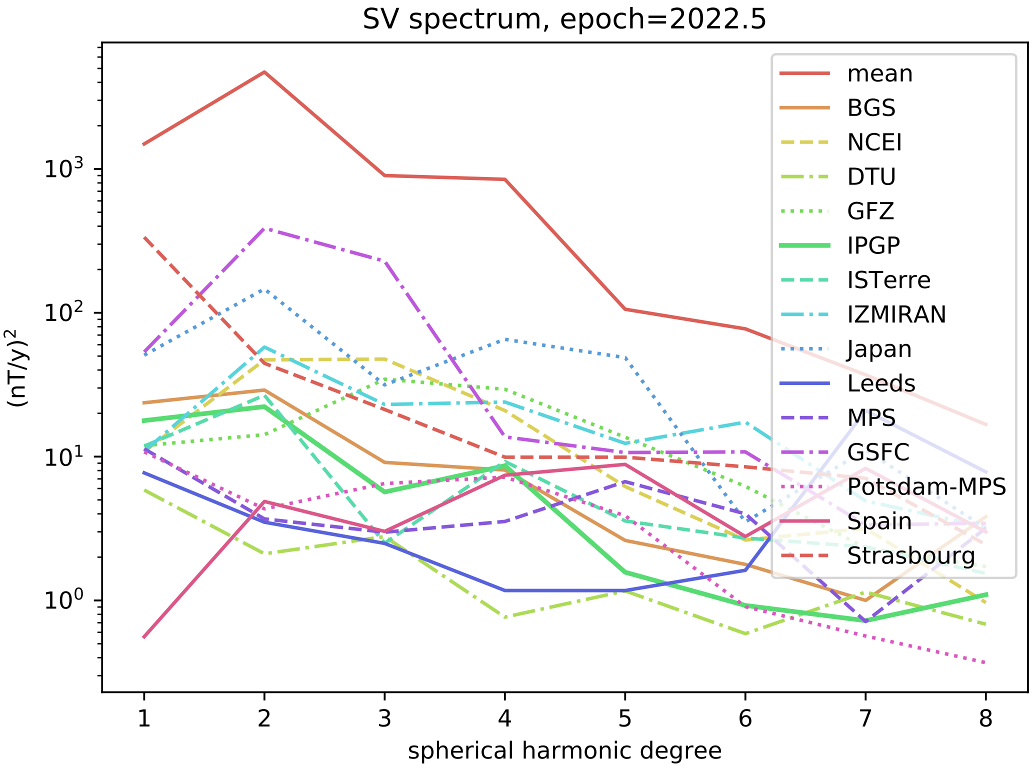

Figure 1. The spectrum of the distance of each model to the mean model.

2 Gallery of differences to the mean

These differences are shown in Fig. 2. Three candidates show relatively large-scale deviations from the mean: Japan, GSFC, and Strasbourg.

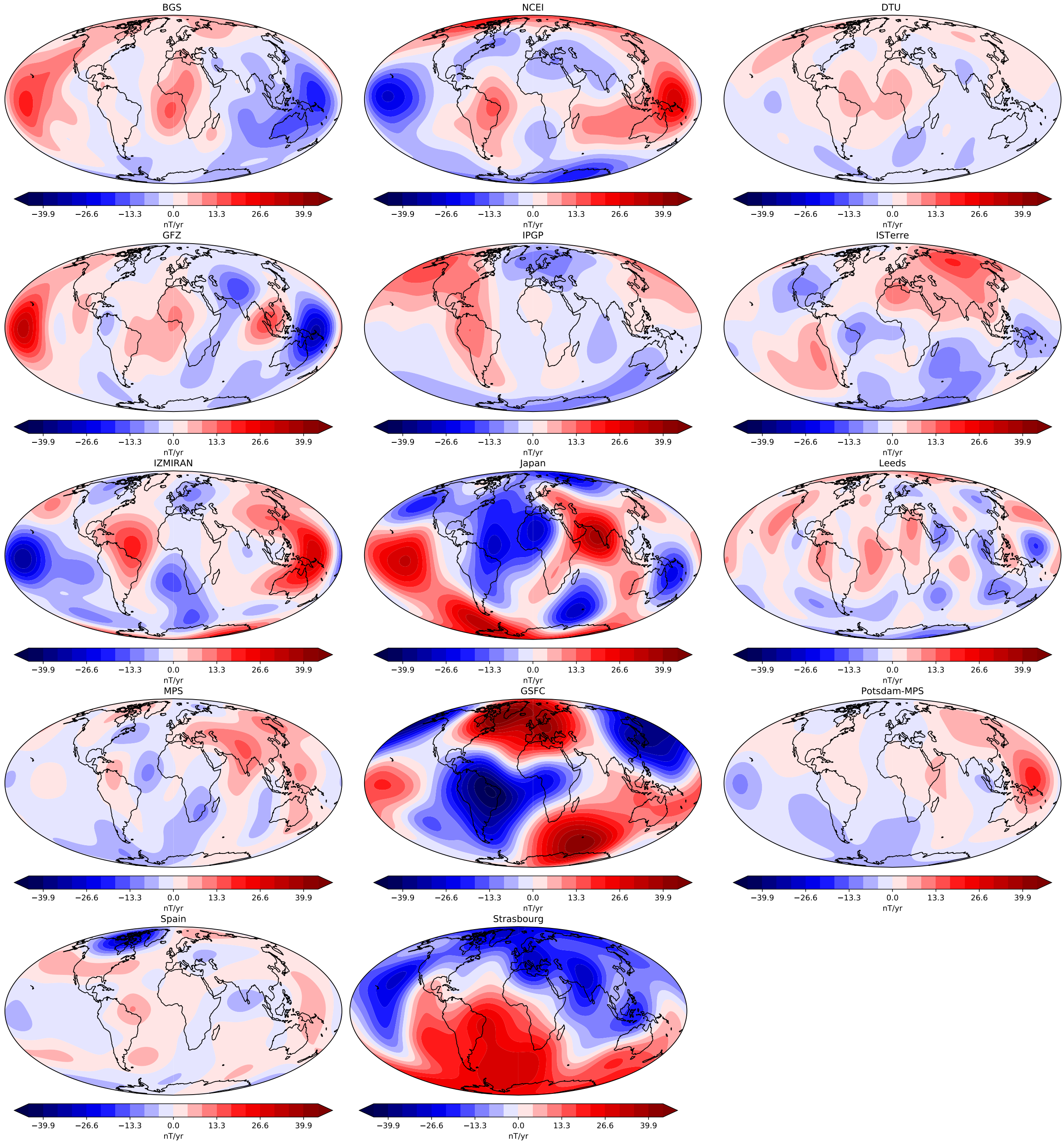

Figure 2. Maps at Earth's surface of the spherical radial component of the difference between each individual model and the mean. The color scale is the same for all maps.

3 Behaviour of individual Gauss coefficients

We conclude this quick evaluation by looking at the distribution of proposed rates of change of Gauss coefficients against the statistics (in terms of probability density function) provided on the one hand by the COV-OBS.x1 geomagnetic model by Gillet, Barrois, and Finlay, 2015 for the 1840–2015 time span, and by the Coupled Earth dynamo model of Aubert, Finlay, and Fournier, 2013 on the other hand – that last model was the engine behind the physics-based forecast proposed by IPGP. We restrict ourselves to the coefficients of degree 1 and 2.

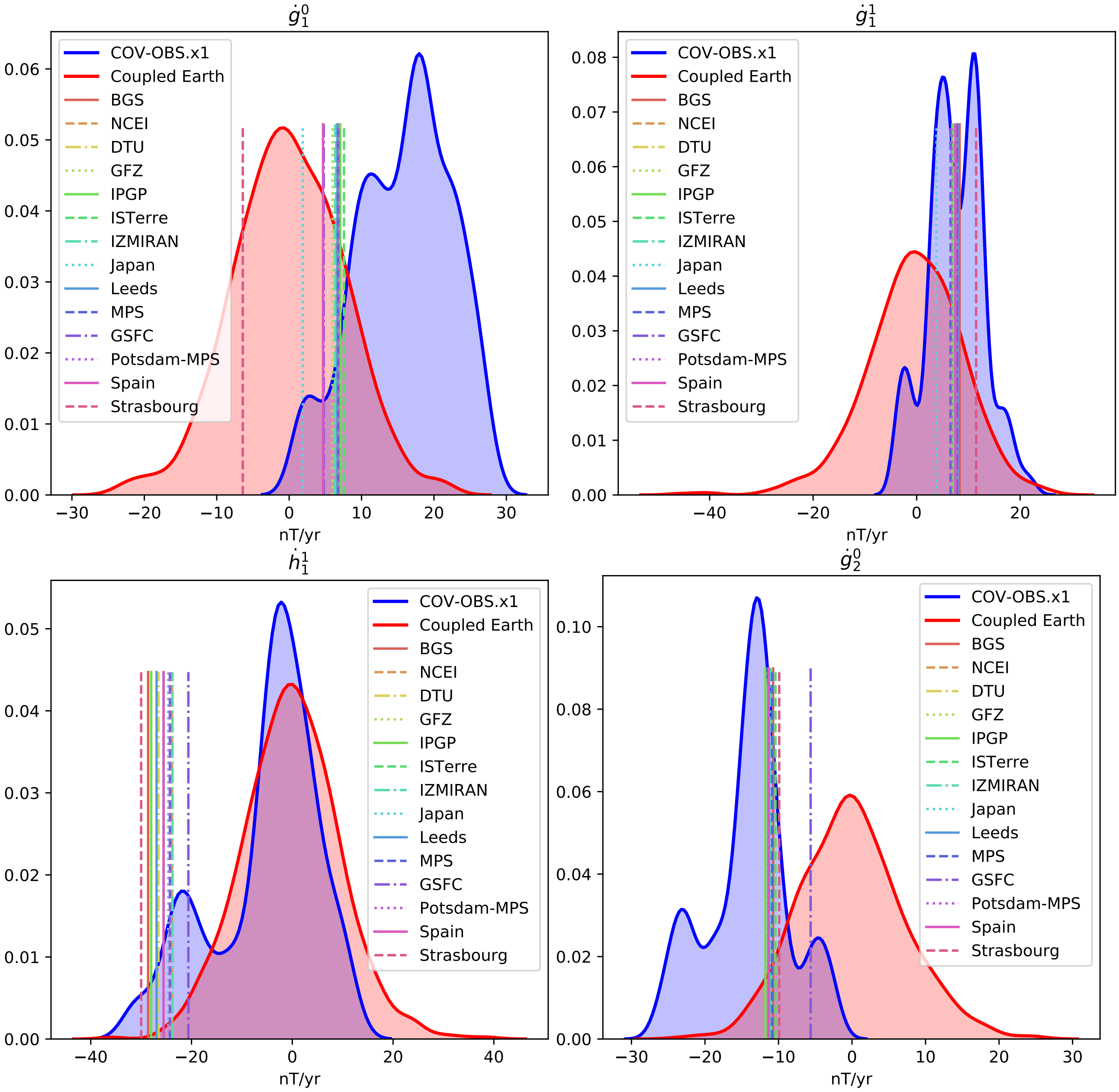

Figure 3. Distribution of proposed rates of change for Gauss coefficients of degrees 1 and 2 against the statistics of the COV-OBS.x1 geomagnetic field model (Gillet, Barrois, and Finlay, 2015) and the Coupled Earth dynamo model (Aubert, Finlay, and Fournier, 2013).

The three candidates displaying large-scale differences with respect to the mean model show also a singular behaviour for certain $(\dot{g}_n^m, \dot{h}_n^m)$. This relative singularity, when it occurs, does not appear at odds with the recent historical behaviour or the simulated behaviour. This statistical statement should not conceal the fact that a transition from the current value of the $(\dot{g}_n^m, \dot{h}_n^m)$ to the value predicted by some candidates requires a very large acceleration (second time derivative). It is also interesting to note that for instance $\dot{h}_2^1$ seems to be undergoing a rather unusual evolution compared with the historical or simulated statistics.

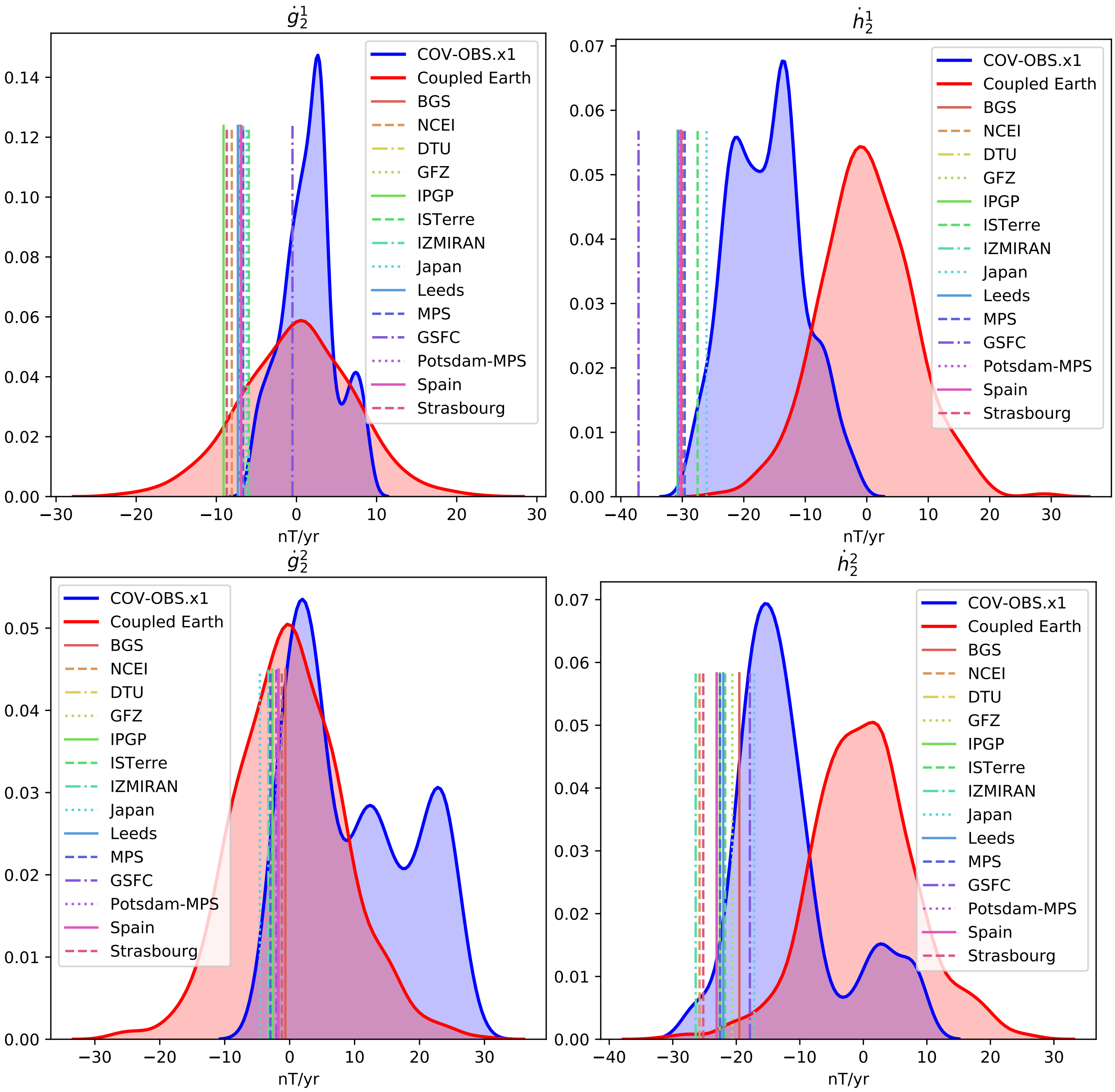

Figure 3 (Cont.). Distribution of proposed rates of change for Gauss coefficients of degrees 1 and 2 against the statistics of the COV-OBS.x1 geomagnetic field model (Gillet, Barrois, and Finlay, 2015) and the Coupled Earth dynamo model (Aubert, Finlay, and Fournier, 2013).

References

Aubert, Julien, Christopher C. Finlay, and Alexandre Fournier (2013). "Bottom-up control of geomagnetic secular variation by the Earth's inner core". In: *Nature* 502, pp. 219–223. DOI: 10.1038/nature12574.

Gillet, Nicolas, Olivier Barrois, and Christopher C. Finlay (2015). "Stochastic forecasting of the geomagnetic field from the COV-OBS.x1 geomagnetic field model, and candidate models for IGRF-12". In: *Earth, Planets and Space* 67.1, pp. 1–14.